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New Anarchy Pamphlet Series

This booklet about the possibilities for creating green, sustainable and self-governing cities in a future social-environmental anarchy is one of a number of related pamphlets concerning specific areas of anarchist theory and practice. By anarchism we understand a future society consisting of self-governing communities enmeshed in the ecological dynamics of the bio-region in which they are located. The idea is not to return to small and isolated villages. Rather, we wish that they federate from the bottom upwards upon a regional, inter-regional and intercontinental basis. Eventually this would form a global federation of bio-regions. Inter-regional trade and communication requires transport, telecommunications, postal and power industries. These vital services will be provided by worker controlled industrial unions operating on the basis of public needs and environmental enhancement rather than for profit. Service industries (childcare, laundry, etc) and small trades it is hoped would be organised along communal lines by the citizens of the commune or region. Other titles in the New Anarchy Pamphlet Series concern themselves with some of the specifics of creating such a society. The series includes discussions of *Mapping Our Green Anarchist Future*, *Law & Authority*, *Agriculture*, *Money*, and *The Anarchist Revolution*.

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PAMPHLET 2

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the Green CITY

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THE GREEN CITY

GRAHAM PURCHASE

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I Couldn't Paint Golden Angels: Sixty Years of Commonplace Life and Anarchist Agitation by Albert Meltzer. ISBN 1-873176 93 7; 400pp, two color cover, perfect bound 210mm x 245mm; £12.95/$19.95. Albert Meltzer (1920-whenever) has been involved actively in class struggles since the age of 15; exceptionally for his generation in having been a convinced Anarchist from the start, without any family background in such activity. **I Couldn't Paint Golden Angels** is a lively, witty account of what he claims would have been the commonplace life of a worker but for the fact that he spent sixty years in anarchist activism. As a result it is a unique recounting of many struggles otherwise distorted or unrecorded, including the history of the contemporary development of anarchism in Britain and other countries where he was involved, notably Spain.

His story tells of many struggles, including for the first time, the Anglo-Spanish co-operation in the post-War anti-Franco resistance and provides interesting sidelights on, amongst others, the printers' and miners' strikes, fighting Blackshirts and the battle of Cable Street, the so-called Angry Brigade activities, the Anarchist Black Cross, the Cairo Mutiny and wartime German anti-Nazi resistance, the New Left of the 60s, the rise of squatting — and through individuals as varied as Kenyata, Emma Goldman, George Orwell, Guy Aldred and Frank Ridley — all of which have crowded out not only his story, but his life too.

"If I can't have a revolution, what is there to dance about?" — Albert Meltzer

ways of gaining energy from plants. By using chemical synthesis rather than photo-synthetic properties of plants and bacteria a host of useful products may one day be used in a future Green City. For example, the microscopic alga *Anabaena azolla*, that is cultivated in rice paddies to fix nitrogen, can also be made to produce hydrogen from water. Perhaps this could be used as a fuel. Mercedes Benz, BMW and Ford have all been conducting research into Hydrogen powered cars. There are many, many other living or organic technologies, most yet to be discovered or invented, which might one day be employed in making the dream of a sustainable city a living reality. It is simply futile and silly to predict how people will live in 50 years from now. In this pamphlet I have generally restricted myself to looking at a few examples of how using plants, animals and bio-architecture within integrated urban eco-systems could transform our cities NOW! upon the basis of quite simple and readily available scientific/horticultural literature. The construction of the organic cities of the future will no doubt turn out to be nothing like what I have out lined. However, It is hoped that the above examples are illustrative of how simple bio-technologies could transform our cities so that they function as sustainable organisms. Each city will have its own specific problems, related to its different climate customs, taboos, and topography. The inhabitants of the neighbourhood, street and quarter must learn to co-operate. They must learn to mix the organic and inorganic resources of their space in order to produce a stable and rich eco-system that can deliver an array of useful products by exploiting useful and intersupporting natural connections that form viable ecosystems. We foresee a r/evolution in naturalistic, native and edible landscaping. We live in the hope that the Red Kite (considered a pest and exterminated in the 16th century) might once again swoop down upon the streets of London. We do not make grand schemes for the reconstruction of Paris like governments and planners. We appeal rather, to the people of each neighbourhood, to do it for themselves. If Mr Brown has nominated to have his house moved to enable us to liberate a creek passing underground there, then the builders, carpenters, electricians and plumbers, of the neighbourhood must help him move it, or better still, build a new one according to all the latest energy saving specifications. Announce to everybody what you are doing. Hold an open day to explain the special features of the house and to show-off your beautiful landscaping of new banks of the liberated creek. Call in the expert by all means, but: Act For Yourselves, upon a suburb by suburb basis, for the renewal of the life and vigour, of that part of the city which you inhabit.

Realism versus Primitivism

There is a current fashion amongst certain green circles to idolise hunter-gatherer and larger tribal societies. These people have become known as neo-primitivists. They advocate a return to extremely small scale societies in the absence of even the simplest of technologies. Even the push bike, we are told, as a product of industrial culture must be abandoned. For does it not require iron ore mines, steel mills, chrome platers, nut & bolt machines, assembly plants, tarmac roads; indeed the whole support of the industrial megamachine, to simply provide everyone with a bike and the roads upon which to use it!? "It is the industrial megamachine as such," the neo-primitivists claim, "whether it be run by capitalists, state socialists or worker controlled syndicates that is the cause of the present ecological crisis". "Humankind must abandon its technology and return to the woods and the plains". "Humanity must attempt to recreate the innocence and environmental stability of pre-industrial cultural life". "The future is primitive!" they loudly and boldly proclaim.

We cannot but be sympathetic to this viewpoint. Marshall Sahlins' widely read book, *Stone Age Economics* (one of the bibles of the neo-primitivist movement) as well as a large number of similar books has conclusively shown that pre-industrial societies were neither inferior, nor primitive. Stone Age people living in hunter-gatherer societies, through dispensing with property and keeping their needs simple, existed upon a healthy and diverse diet. Stone-age people led an active and fulfilling life. Often they worked considerably fewer hours than the modern worker of today. Moreover, these societies achieved all of this whilst maintaining a sustainable and rich relationship with the ecology of the bio-region in which they lived. Whatever the technocrats might tell us about the supposed benefits of "industrialism, growth and progress", recent studies of small-scale pre-industrial cultures has revealed the opposite to be the case. It can be reasonably argued that stone-age economics can be more viable, in both social and environmental terms, than our industrial economics of today.

On the other hand, the human individual has to learn to fit into an eco-system or bio-region. The detailed knowledge of how to achieve this does not come ready made and is not encoded in our genes. When the descendants of the Australian aboriginals arrived upon the island continent some 60 000 years ago they were met by a large number of massive marsupial herbivores and reptilian carnivores, whose extinction (carbon dating has shown) coincided with their arrival. 40 000 years ago Australia had giant wombats and large kangaroos which browsed the trees. There were also huge predatory reptiles, the most unusual being a giant land crocodile which got about not on claws but on hoofs. A carnivorous goanna measuring seven metres in length roamed the plains as little as 15 000 years ago. There is evidence the giant marsupial lion and hippopotamus like animals were still extant a little more than 2000 years ago. Although some

of these extinctions can be attributable to the continued drying of the Australian continent, humanity undoubtedly played a role. Australia had in actual fact large game similar to that which still exists in Africa today. It is not difficult to imagine why the aboriginals exterminated these animals any more that their counterparts in Europe exterminated the mammoth, wolf, lion and the bear.

The aboriginals in the 20 000 years that followed the majority of these mass exterminations eventually managed to live in harmony with the environment. This relationship was not a passive one. Through continued and seasonal bush burning practices, the aboriginals, far from simply following the 'flow of nature', did rather consciously and purposely manage the land. With the European invasion these fire management processes were rapidly interrupted. The fresh shoots, that always follow fire were no longer available to thousands of small local and regional marsupials which rapidly became extinct. The fox, cat, rabbit etc., rapidly finished off those marsupial species that were less local and more widespread. To this day the Australian continent has a higher rate of extinction than any other country in the world.

The Maoris of New Zealand, upon their arrival in those distant southern isles, after island -hopping there attacked and then 'integrated' with the original inhabitants. Like the Kooris of Australia they carried out large-scale deforestation and the hunting to extinction of 12 species of giant moa and the world's biggest eagle which used to prey on them. Both Australia and New Zealand have had two periods of mass invasion and extinction and not one as is commonly believed. The Aboriginals and Maoris *learned* to live with the land, such knowledge was not automatically available to them, and they only did so after a considerable period of time. Likewise many Polynesian Islands had huge herbivorous rats. Massive mounds of giant rat bones have been found in the Solomon Islands. A rat that was the size of a bear was hunted to extinction, for food, in the Caribbean not long before the arrival of Columbus.

The mass extinctions have already occurred and there is nothing that we can now do about it. Industrial culture like the Australian Aboriginal cultures of 20 000 years before, must learn to adapt its culture and technology so that it can learn to live in harmony with both the regional and global ecology of the Earth. Steel mills can be made to work very well upon a small scale. Bicycle tracks hardly occupy the same space as a modern freeway system. The potentiality of pollution free energy sources are only just beginning to be adequately explored. We must accept that industrial culture is as responsible for ecological damage as that of capital & state, but to suggest that we can return to an essentially hunter-gatherer existence, although not impossible, is about as likely to achieve success as the search for the Tasmanian tiger. Industrial culture's relationship with the natural world must be one of respect, reconciliation and gradual understanding. We cannot retreat into the past. The irreversibility of time and evolution will not

bicycles, is completely automatic, requires no attendant and can be used 24 hours a day. The very low population density of many outer suburban areas means that there is an opportunity to think about integrating bicycles with new trunk bus routes. If there were circumferential (circular) express bus services linked to the rail lines that radiate out from the central business districts, bike/rail-express bus services could be used by nearly all able-bodied people in the major cities" (Soft Tech. #51 p38)

Solar powered-transport would be ideal, however, solar technology, although improving all the time, has a long way to go. The answer to the transport problem in the medium-term probably involves looking at a variety of alternative fuels to replace the use of exhaustible and polluting fossil fuels. Vegetable oils similar to that used to cook your chips can supply at least some of our fuel requirements in this respect: "According to the Dept of Agriculture, vegetable oils from grains such as canola can substitute for indirect injection diesel engines without modification to the oil or the engine. Vegetable oils deliver many benefits as an alternative fuel as it produces a low emission vehicle with less particulate matter and nitrous oxides than diesel. Supply of vegetable oils for cars can be derived from industrial waste from food outlets, putting all that waste oil from fish and chips to good use. It is however, widely believed within the energy industry that we would never be able to produce enough vegetable oil to enable us to rely upon that source alone" (Soft Technology #54 p.36). Ethanol produced from waste products has been widely used in Brazil for many years. Coconut oil can also be used in diesel engines and is an option for south-sea islander communities as an alternative to expensive fuel imports. Hydrogen "is one of the most promising fuels of the future. Hydrogen emits only water, making it potentially the cleanest fuel on earth and can be extracted from water by electrolysis"(ST #54 p.39). Hydrogen powered utilities are now only at the research stage but may one day provide a clean, safe and efficient fuel for our transportation needs.

Conclusion

All we have done is to have briefly sketched a very few of a large number of organic processes that could be utilised within an urban context. Technology and human inventiveness is moving in so many different directions it is impossible, indeed foolish, to predict how a future Green City might be organised. Every day developments in creating bio-plastics and bio-energy are providing us with glimpses of a time when everything within the city will made be made of safe materials, or from organic botanic-chemicals that are readily and harmlessly absorbed back into the soil. Scientists are now coming ever closer to understanding how simple bacteria and plants gain energy from photo-synthesis. The utilisation of the methods by which plants produce energy is a dream that might yet be realised. However even if it is never realised there are many other

and diverted down concrete storm drains. Many of these waterways, once liberated, could provide opportunities for the energy exploitation by micro-hydro systems. In regions with long alternating wet and dry seasons, or during periods of prolonged rainfall, micro-hydro can produce energy for lighting when solar sources are not plentiful.

Local electricians, plumbers, architects, engineers, landscape-gardeners etc., must assess the potential for integrating building designs which minimise the need for expensive energy inputs for heating and cooling. Better designed houses must be combined with the increasing us of local micro-hydro, solar, wind and bio-energy systems. It is the task of inventive workers to design and manufacture, simple, universal systems, that are adaptable to a myriad of local peculiarities.

Urban wilderness Parks

Local pockets of ancient woodland and wilderness must be designated as urban wildlife habitat reserves. Within the cityscape these areas are extremely precious. The inhabitants would be well served, not only to seek to preserve them, but to expand their sphere of influence. Planting adjoining gardens with the trees and bushes of the reserve, whilst eliminating unnecessary boundaries and fences, will allow the surrounding people to integrate themselves back into the natural life of the region. Wildlife corridors that connect substantial pieces of natural habitat in the city, with the surrounding countryside, has been suggested as a way of encouraging animals into the life of the city once more. This would most obviously occur along the liberated waterways of the Green City.

Transport

Much of the modern city scape is taken up by roads. The adoption of self-propelled transport, such as bicycles, and the increasing use of light-rail networks, could liberate significant areas of the city for more useful purposes. We can imagine, for example, aerial bicycle ways that can accommodate very small solar or solar rechargeable battery cars. Underneath them, there might be trams or light rail systems. These would be built and maintained by worker controlled transport syndicates for the benefit of all the inhabitants of the city. Centralisation means that most train (and bus) routes go outwards from the city like the spokes of a wheel or a spider web. Unfortunately, unlike a wheel or a spider web, these spokes are not joined together, either at the edge like a wheel, or at regular intermediate points along the spokes, as in a spider web. It has been suggested that bicycle storage areas at railway stations and the provision of bicycle carrying trunk buses joining the spoke-like rail lines would greatly improve the usefulness of suburban public transport systems. In Japan and Holland there has been a move in the direction of cycling to (light) rail stations. "The Dutch have also developed a unique bicycle storage system. The *Ficcaro* system stores up 88

allow us. The damage is done. The equilibrium of the past earth/culture balance has been ruptured. We must find a new one. Industrial culture must forge a new harmony and develop a new and lasting relationship with the natural world. There is no other practical road that is open to us.

Look Back Before You Leap Forward

Industrial practices must be scaled to the needs of the region rather than that of the nation state or large city. They should be community based, non-profit making and non-polluting. Their products and by-products need to be readily biodegradable. They should employ regionally sensitive technologies using local energy sources. If we down-scale our industrial practices it will also be necessary to down-scale the size of our major cities and towns. Wind and solar energies, typically provide much smaller amounts of energy upon a local basis. They are not ideally suited to providing the house hold and industrial energy requirements of a city of many, many millions of people. These are not new ideas. Similar visions suggesting networks of small community run workshops scattered amidst the fields of the village community or rejuvenated city was advocated by a large number of progressive thinkers in both the 18th and 19th centuries. Most famously perhaps, by the 18th century French philosopher, Charles Fourier, and the 19th century Russian anarchist thinker, Peter Kropotkin.

The transition from the tribal band to the nation-state was not a sudden one. The city or town was regarded by most people as the fundamental basis of human life. The human-individual was a citizen of a particular city, which he or she had helped to build and nurture, throughout their lives. Humanity having freed itself from the narrow confines of village and tribal life became a citizen of a city, rather than a member of a particular tribe or clan based upon blood connections. Civic life is not a superior or more advanced form of social existence. It does however represent a better basis for society than either the nation-state. tribalism or the pre-industrial hunter-gatherer community. The nation-state is too large and unwieldy an institution to give proper attention to the differing regional peculiarities of the land The tribal band is too small, and narrow, an institution. It cannot easily be re-created.

The properly scaled and environmentally integrated city-region is perhaps a more plausible basis around which to develop the society of tomorrow. It is regarded by a large percentage of bio-regional thinkers and activists as the most pragmatic option. Having said this however, it is necessary to state that humanity creates its cities and institutions. Humanity can destroy and modify them as it pleases. The future is always an ever-open book. Social evolution is not a one-way passage of development, that begins with the tribal band and ends with the nation state. The bio-regionalists by arguing for the dismantling of the nation-state and our return to the self-governing city or town, acknowledge that it is necessary to look backwards to progress forward. Bio-regionalists ask us to

respect the great knowledge and resourcefulness of indigenous people with regard to the ecology of their region. However they understand that we must blend the best elements of the city-commune and the organic community into a new form: The Green City

City Limits

In the course of human history there have been many types of human social and political organisation; tribal bands, tribal village communities, city-communes and state nationalism. All of these exist in large variety of mixtures, graduations and forms within the social life of humanity of the present day. In some parts of the world small tribes still live and identify with a particular forest or desert region, of which they see themselves as an integral part, and from which they gain their entire livelihood. Other people, by far the vast majority in many parts of the world, live in large urban environments. Such people have no direct connection with the ecology of the city or area in which they live. Instead they identify with an abstract and synthetic notion of the nation state. Indigenous peoples, villagers and minority peoples are everywhere fighting back against the forces of state-capitalist imperialism. It nonetheless remains a fact that due to mass migration during the next few decades, by far the vast majority of the Earth's human population will be living in the world's largest cities. Our immediate problem is not how to get people to live in small tribes. It is how to get people to live in smaller and more bio-regionally integrated cities!?

The bio-regionally integrated city is not a remote or abstract principle. Most cities in Europe functioned very well for many centuries by means of civic autonomy and self-government. The nation state is an extremely modern and unstable development. In Europe states are multiplying and disintegrating. The artificial boundaries of state-capitalist imperialism are everywhere exploding. The Bio-regionalist asks us to take this process several steps further. They ask us to forget the petty / petit nationalism of a past tribal era by getting people to identify with the ecology of their region instead. Indigenous peoples continue to fight wherever they are threatened; the Zapatista insurrection in Southern Mexico restarted again in 1993 for example.

We should perhaps remain deeply critical of a predominantly urban human lifestyle. We cannot deny its present and overwhelming dominance. Some of us romance about returning to very small scale village or isolated community lifestyle. To assume that the majority of people would find this type of life-style appealing, or indeed necessary, seems at the very best, a dream of the remote future. Humanity if it is to solve the social-environmental problem, must, first and foremost, solve the social and environmental problems of urban living.

The theme of 'crisis in our cities' has become a standard subject of concern in the editorials of our national newspapers. "Mexico city 30 millions by

demands of nearby 40 000 residents of the desert playground of Palm Springs. However, in this millionaire's fun-trap, each resident uses almost twice the average US house-hold consumption. About 1000 of the older units are being removed and replaced by 150 new state-of-the art turbines, which produce more power together than all those they replace. The installation costs are marginally greater than those of a natural-gas fired power station but cheaper than many other options. It is on the side of maintenance and running costs that the real difference occurs. If environmental benefits, such as air quality, are taken into account then it has been estimated that the environmental benefits exceed the total cost of the wind turbine. Meanwhile, it was a wonderful, refreshing sight to see horses and cattle wandering among these giant metal trees" (Soft Tech. #51 p.76-7) Large-scale solar-power-generation is also possible. However, the few ventures undertaken in the USA during the Carter administration, were never continued, due to lack of investment/support.

A site is suitable for a wind power system if there is an average annual wind speed in excess of 4 metres per second. It is also necessary that the wind current is smooth and there is not undue turbulence. The power available goes up by the cube of the windspeed. This means that a 10m/s wind has 8 times more power than a 5 m/s wind. The windspeed nearly always increases with height. The extra bother of constructing a taller tower or installing a copper cable to reach an adjacent hill top is usually compensated by considerable gains in energy output. Nearby obstacles, such as trees, buildings and hills can create turbulence that severely limits the effectiveness of the system. To avoid these destructive effects it is essential to erect the tower at least 5-10 metres above any obstruction within a radius of 100 metres. Turbulence can often be assessed by flying a kite with ribbon streamers attached to it in the area. Where the terrain consists of gently rolling hills the windspeed will be greater than average near the top of the ridge, moreover, it tends to be smooth and free of turbulence. However, in terrain with steep vertical cliffs the top of a ridge is usually characterised by very turbulent wind gusts that are unsuitable for wind energy systems (this general information from Soft Tech #46 p33-7).

Micro or low-head hydro-power generators have been particularly successful in remote locations, such as small islands, where the cost of importing other fuels is very expensive or not economically feasible at all. For example, the Australian APACE organisation has designed and installed a number of these small systems. Their most recent project is on the small Solomon island of Kolombanagara, and was completed in 1993. "APACE micro-hydro systems are built to provide lighting and small scale power for local industry. Typically the system will generate about 5kW. This is enough to service the basic electricity needs of a small village of, say, one hundred people. The technology can range to over 100kW but such a capacity would rarely be justified in rural contexts"(Soft Tech #45 p.46). Rivers and Creeks in our cities are normally covered in tarmac

was a series of deep ponds surrounded by an impenetrable canopy of giant bamboo. Heat after passing through the brick and slate cooling tower is then slowly dissipated through the ponds.

Energy Sources of the Green City

The "*Solar 1 project*" is a recently constructed house in south eastern Queensland that combines passive solar construction when with active solar collectors (photovoltaic cells) consisting of a 1.3kW photovoltaic array consisting of 16 *Solarex* MSX83 panels configured in a series parallel array. The 12 metre^2 array produces 96 volts DC and averages 6kWh per hour. No batteries are needed as the power is conditioned to 240 volts and fed into the normal electrical grid system. The grid itself acts as storage system. On sunny days the house produces excess electricity which is fed into the grid. At night or in stormy weather electricity is obtained back from the grid. In the experiment it was found that the house had given more to the grid then it had taken. (Soft Technology #51 p.33-4) One can imagine future settlements which rely, in emergencies, upon remote sources for their power needs, but gain all their domestic energy needs locally, most of the time.

There are many innovative applications for active solar systems. One interesting new product is that of photovoltaic cells shaped to fit into traditional clay tile roofs which are manufactured by the Swiss company *Newtec*. The tile weighs around 6 kg and covers the area of 5 normal tiles. They can be integrated into most sloping roofs as they require a minimum angle of only 20 degrees. The tiles are not only suitable for housing but can be used wherever there is roofing eg., sheds garages and industrial buildings (ST #53 page 18-19). Photovoltaic cells are also beginning to be placed along freeways. Following a successful project in Switzerland, solar cells are going to be placed along the Tullamarine Freeway in Melbourne (ST #51 p30-1) This system, if successful, could perhaps be used along the tracks, to supplement the power requirements of light rail networks.

All domestic energy requirements can be provided by local solar, hydro & wind installations as well as bio-gas derived from communal composting at the level of the individual suburban community. Industrial needs require larger quantities of energy that has to be obtained from outside of the immediate locale. Large scale windfarms supplying part of the energy of whole communities have recently been developed in many places along the North European Coast. The most ambitious example to date is the San Gorgonio Pass Wind Farm in Southern California. "At the wind farm there are 4300 wind generators humming away. The pass is between two mountain ranges, both of which are over 3000 metres high. The pass connects the hot desert, east of the mountains, to the cooler valleys and coastal areas in the west. Its geography is crucial to the operation of the wind farm. The power generated is only enough to supply the power

year 2000"!, "Two billion city squatters by end of century!", "What future the Mega-city!?", announce the headlines of the feature pages. Asthma, respiratory problems, poverty, unemployment and violence are just some of the ills, medical, social and economic, that the bourgeois press, on a daily basis, claims is directly attributable to the modern city. In the latter half of the twentieth century there has been a shift of people from the country to the city which has been unprecedented in all of history. It will not be long, if present trends continue, when the vast majority of the world's population will live in several hundred mega cities. If things are bad now they can only get worse. This gloomy and pessimistic warning has become accepted wisdom by the establishment press. Their only solution is to predict the collapse of civilisation in a cloud of dust, smog and a desert of pot-holed asphalt, squalor and disease.

The solution to the urban problem, when they suggest that there may even be one, tends to consist of a series of partial solutions. These are to be implemented bureaucratically in a top-down way by government departments and highly paid experts. The media occasionally trundles out a university professor of urban planning. Local councils make piecemeal attempts to "green" their area. Parking fines are trebled to "discourage inner-city parking". A little discussion, block off a few streets and harass motorists in an unplanned and authoritarian way can only cause greater despair and misery upon our streets. Speed bumps over which residents were never "consulted" also slow down ambulances and fire engines. Motorists unable to rely on public transport are robbed upon a daily basis of their meagre wages. University lecturers and city architects talk in abstract terms about "the need for higher density housing". This can only mean uniform stacks of rabbit hutches for the poor. In England they have put massive taxes on heating and in Australia upon water. This is justified on the grounds that it will act as a deterrent to "waste" energy and water. The poor and elderly are left to freeze in England during the winter in the name of environmental sanity!?

What is needed rather, is a holistic, local, direct-actionist and unified-communal approach to the urban problem. First of all the city must come to be seen as part of the bio-region as well as an ecosystem in its own right. The modern mega-city has not attempted to integrate itself with the natural dynamics of its ecological region. In fact, it has too often covered entire bio-regions in tarmac, concrete and steel. The mega-city imports hundreds of thousands of tons of water, food, timber and other materials upon a daily basis. It also spews out hundreds of thousands of tons of garbage. It draws thousands of tons of life-matter from far flung regions at great cost. After consuming what it wants it dumps its leftovers in its own backyard — usually by means of crude landfill practices. Thereby poisoning the surrounding countryside upon which the city used to depend for its food. An eco-system that draws scarce and limited resources from outside of its eco-region, and poisons its own eco-region with its

wastes, is an eco-system that stands no chance whatsoever of surviving in the long term. History reveals the collapse of 'Great Empire Cities' as they became unsustainable.

If the modern city is to survive it must become a viable eco-system in its own right. Ideally, even enhancing the ecological region in which it is located. Through collecting and recycling local water and wastes; and producing food and energy, the city must attempt to become a self-sufficient eco-system. Although it is perhaps utopian to expect that the city might become self-sufficient from its own internal resources, in everything except air and sunlight, it must begin to decrease its impact on surrounding country regions whilst seeking to minimise and even eliminate imports from other places. In this way the bio-region and the bio-regionally integrated city-commune will come to form the environmental and social basis of the Green Commonwealth. The city becomes a living organism rather that an inorganic machine.

The city is not an amorphous and undifferentiated blob. It is naturally divided into neighbourhoods, on the basis of topography, culture, age, architecture and so on. The neighbourhood around a bay or port assumes a different character to that in another part of the city. Differing ethnicities, age groups, industries and classes all serve to carve the city into numerous districts and departments. Endless urban sprawl has obliterated much neighbourhood consciousness and vitality. Yet even the newest, and seemingly most barren of suburbs can sometimes, and quite rapidly, develop its own distinctive character. A distant suburb in Los Angeles may become populated by Chinese, whilst another in Sydney's west by Vietnamese. Although people in the modern mega-city are very alienated from one another, humans have never lived in large anonymous herds and naturally seek community. This fact is apparent in some of the most formless and grotesque of urban places upon Earth. The neighbourhood is sufficiently large, and yet sufficiently small, to ensure tolerable degrees of both community and social anonymity. Along with the ecological region and the self-governing town or city, the extended neighbourhood represents an organic basis upon which to found a stable commonwealth of people. The citizens of the whole city will have to meet and reach agreement on issues that affect the whole city. It is however, at the level of the neighbourhood that the most fundamental changes must occur.

Neighbourhoods have been disempowered by individualistic TV dinner centred suburban lifestyles. Party political councils are only ever near your door when it is election time. It is my hope that city-neighbourhoods will empower themselves to act as a community; and then set about the grand task of greening and reconstructing that part of the city in which they live. The people in the poorer suburbs, instead of waiting for government or some fat capitalist to employ them, should self-employ themselves in the production of local food, energy

keep out the cold. An essential aspect of passive solar house construction is to provide thermal mass which traps sun and releases it during colder periods. Trombe walls or pillars are situated in areas *inside* the house which catch a lot of sun. Insulated mortar filled brick pillars can be constructed inside northerly facing glazed areas. Clerestory windows (from the old English for "clear and storey" and most commonly seen in straight rows of windows in cathedrals that are constructed on a wall above aisle roofs) that run the length of north facing walls can be backed by a brick wall which absorbs the heat from winter sun. Concrete floors are also essential, preferably paved with heat absorbing dark slate. Here one is using a chunk of the earth's mass to store heat on your behalf (information from Soft Technology, Journal of Australian Alternative Technology Association #51 p.14-16 & #45 p.35-9). The possibilities of passive solar heating around the home and office are almost inexhaustible. One recent example of passive solar is that of a "solar fence": a swimming pool heating system that warms the pool by pumping water through the surrounding safety fence. The special glazing which covers the hollow vertical fence tubes prevents loss of heat from wind. (Soft Technology #46 p.9)

By integrating glass houses, by means of windows on sloped roofs, or in the form of conservatories, dwellings can be pre-designed, to entrap the maximum amount of light energy and heat. Collected heat can be conserved in water tanks or Trombe walls. Vents can be opened to let heat into the house. In hot countries the updraught from vents can be used to create cooling drafts through drawing air from an especially constructed shade houses attached to the dwelling, or by means of an underground pipe to a heavily shaded pond in nearby Gardens. A shade house should be situated in a cooler part of the building. A shade house can be made up of a simple frame. This is covered by climbing plants that lose their leaves in winter, such as grape vines. Then it will only provide cool air in the summer, when it is needed. Vents from the shade house should be placed at the floor level and through the eaves of the roofs. This provides updraughts which draws hot air out of the building by means of roof vents. Cross ventilation in hot and humid climates (closeable vents from two or three directions) is particularly important and can eliminate the need for air conditioning, especially when combined with energy efficient ceiling fans.

Ecologists are just beginning to understand that Elephants deliberately create the ponds in which they cool themselves in summer. The water-hole is the collective product of the elephant herd. Likewise, by consciously integrating heavily shaded ponds into urban architecture it is possible to significantly reduce the effort of cooling humans down as well. Recently I was gardening at a large dentistry practice in Glebe (Sydney) and was struck by a curious construction composed of layer upon layer of bricks, slate and rubble out of which water trickled in every conceivable direction. Upon inquiry I was told that this was the water cooler for the air conditioning system. Concealed behind the construction

common lands through providing cheap pasture or land to organic land-sensitive farmers. Others aim to ensure a supply of cheap or communal housing. Some are formed to preserve pristine pockets of wilderness. Many people see CLTs as a legal and peaceful way of taking land out of private ownership with the ultimate aim that all land should be held in common. If every family were guaranteed a decent house, clothing and food, rather than a few percent of the world's population wallowing in sumptuous mansions then few people would want to own their own home. A life-long lease with a CLT is almost the same as owning your own place.

House Construction

Energy conservation and house construction are intimately connected. In colder countries heating is by far the greatest user of energy. Using electricity from a power station is extremely inefficient, only converting some 30% of the energy into heat. Power stations can be made smaller so that heat which would usually go up the chimney, and elsewhere, can be used to directly heat water in surrounding dwellings. In this way, the municipality as whole can minimise its heat-energy costs. When bio-mass material is used instead of coal or coke it is renewable in the sense that the carbon is taken up in the leaves and stems of the next bio-mass crop. At the level of the individual house or block, insulation, if placed on the outside of the walls, then the walls become significant heat-stores as well. There has been an awful lot of research money from big-business that has gone into developing expensive solar collectors. The benefits of using passive solar energy has been deliberately down-played. Although much can be done to make older houses more energy efficient, it is modern houses that must be designed to take maximum advantage of natural heat flows. Passive solar design requires the dwelling to be constructed in such a way that it is warm in winter and cool in summer. In the southern hemisphere cold winter winds come from the south and hot afternoon sun comes in from the west. Southerly walls need to be constructed of heavy masonry, but must have enough openings (that can be open and closed) to allow southerly winds to cool the house in summer. The western aspect needs to be shaded from hot afternoon summer sun. This involves having nearly 20% of the house covered by glass Most of this is on the northern side of the house but some on the eastern and western sides in order to catch morning and afternoon sunshine in the winter. Generally the house must be designed so as to allow as many rooms to be warmed by winter sun. By carefully calculating the differing angles of the sun at different seasons it is possible to construct overhanging eves and adjustable awnings over all glazed areas that screen out the hot summer sun. Modern solar tracking devices can automatically open and close awnings in accordance with the cycle of sun. Tightly packed insulation in the roof and walls helps to reduce both the summer heat and winter cold. Heavy, double-lined curtains or shutters are essential for winter nights to

and water for the benefit of themselves and their neighbours. The tarmac must be dug up, allowing native fruit trees to be planted. Springs, streams and creeks must be liberated from their stormwater prisons. Many of the world's cities were founded on some of the most fertile regions of the Earth. It is truly astonishing to what extent the city's natural waterways have become integrated into the sewerage system or simply hidden and imprisoned in steel and concrete pipes. I always recall how my 90 year old great grandmother, who lived in central London, never forgot to remind me: "that underneath the street, a large stream still flowed down to the Thames river".

Simple measures, such as the adoption of self-propelled transport (eg. push bikes), or the establishment of community vegetable patches on vacant blocks are being taken seriously by many inner-city residents around the world. However by municipalising land at the neighbourhood level and rejecting the parcel-like treatment of suburban land it is possible to liberate acres upon acres of useable communal land in every suburb. Local poultry farms and communal compost depots will provide local employment for local people. Thus begins the process for eliminating of the need to commute to work or waiting for a state / government welfare cheque. In neighbourhood communities and along the natural watercourses and contours of the city local child care centres, book-swap clubs and a whole host of voluntary mutual aid associations are formed to take the place of impersonal government agencies and mass-trash culture. The social alienation, which causes so many of the criminal and loutish tendencies, is significantly curbed by community pride and self control.

Small is not necessarily beautiful. Peering from behind curtains, local gossip and fending, can be as harmful and damaging to individual and community self-esteem as any prison torturer or corporate developer. Life can no longer be confined to the village. A symphony orchestra, a football league or an inter-suburban railway cannot be operated on the level of an individual suburb. Modern people demand cultural and scientific centres. The young will always wish to fly the nest and feel the world's currents and movements for themselves. We foresee a network of districts and suburbs. These would be semi autonomous and partially self-sufficient. They would be federated around a common cultural centre. The cultural centre must contain space enough that the citizens of the city can meet collectively to discuss the great issues of the day. The proposed path of a nature corridor connecting the nature of the region with the inner city, or the direction of inter suburban bicycle freeway, and all the other vital issues that confront a living and freely evolving city will have to be worked out.

The know-how and technology to achieve this desirable end is already available. Let us briefly examine some of the practical steps than can be taken towards creating greener and more sustainable urban places:

Reusing and Recycling

Firstly it is preferable that things are reused rather than recycled. To collect bottles, smash them up, and melt them down again, only to produce the same bottle, when it could simply be returned and reused, is wasteful and stupid. And yet most city recycling systems operate on this basis. Reuse is always preferable to recycling. For example, used clothes, which are too small, or disliked, are very rarely thrown out, but passed on informally. Unfortunately damaged or unfashionable clothes are often thrown in the garbage bin. These can of course be altered for resale at local markets. However, before the criminalisation of Hemp, most clothes were made of Hemp fibre. Clothes rags were collected and then made into high quality paper for writing and printing. We must look at all of our household and municipal inputs and outputs in much the same way. We wish to do away with the conventional garbage bin forever. The dynamics of an eco-system, more often than not, operate on a primary or 'at source' recycling basis. An isolated patch of rainforest in a sea of agriculture can maintain its vigour precisely because it recycles all its waste locally and naturally. The urban eco-system cannot be successful unless it follows the course directed by nature. The Key to achieving the Green City, is for each neighbourhood to work towards being able to reuse or recycle everything locally. Egg shells, those little bits of soap or candle you cannot use, aluminium foil etc., can all be collected and cleaned, processed or reshaped into a useful product. A host of local secondary industries, re-using everything and wasting nothing, will not only change the face of garbage collection, but will change the economic face of the whole community.

Urban Worm Farming & Composting

It is now generally recognised that using animal and plant systems to recycle our wastes, as a kind of living machine is ultimately the best, if not the only, safe and efficient disposal method in the long term. Worms can be used without cruelty as a component of a living recycling machine.

Of the 3-4000 species of worm in the world, only a handful are known to reproduce quickly enough, to yield useful quantities of nutrient rich castings, or assist in the rapid conversion of sewerage and other organic wastes. Those very few species which can be used within an urban setting, are largely unsuitable within an agricultural context. *Farming the land*, in a way that encourages high populations of worms, and *intensive worm farming*, are thus, entirely different from one another. 'Pasture' worms live and work in a different way to that of 'compost' worms.

By placing compost worms in simply constructed box-beds large quantities of valuable vermicast can be obtained. Pig and horse manure are preferred, but the use of decaying fruit, vegetable peelings, cardboard, occasionally supple-

continue to live in private homes, but these are clustered together so as to utilise shared common facilities, such as kitchen, laundry, workshops, guest rooms, storage and play areas. Cluster-housing with shared Communal facilities allows for a much greater area of surrounding land that can be used for recreation and food-production. Resident-designed cluster housing systems have much potential with regard to many of the bio-technologies described above. Local, environmentally sustainable approaches to energy, water, waste management and food become much more feasible when a group of people begin to think of the area in which they live as a whole system or eco-system. Much domestic work is simply wasteful and environmentally destructive. Millions of washing machines, fridges, dish-washers and ovens, churn or burn away the precious resources of our Earth everyday. Our houses are crammed full with every machine of convenience. Backyard children's play areas, car-ports and swimming pools are wasteful in every respect. A children's play area, and a swimming pool can be provided in each housing complex for the benefit of all the residents. This would liberate acres of suburban land for food production. Rather than building swimming pools we should be constructing backyard ponds for fish and fowl production—or to encourage frogs to eat mosquitos and snails. District, nappy or linen cleaning services, healthy nutritious food that can be plucked form urban food-forests, communal child-care etc., if organised properly could virtually eliminate individualistically performed housework.

Co-housing schemes, although much cheaper and more pleasant, once established, can be much more expensive than conventional housing in terms of set-up costs. Also, such ventures fail to address land ownership issues. A more communal approach to land ownership is provided by the community land trust model. A community land trust is a non-profit making association open to all members of a local community. Land once acquired by the association is then held in trust forever and thereby inheritable. The uses of the land are restricted by environmental and other stipulations which the original association placed upon its use. In cases where the Trust leases the land, it is usually upon a long term or life-time basis. Leaseholders, which can include, individuals, families, farmers, co-operatives, community groups etc, pay much below the commercial rate. However, there is usually a provision that restricts the profit that a lease holder can make when selling the lease. Dissatisfied with the limited efforts of government and establishment forces, many environmental and social groupings have been attracted to the concept and practice of 'Community Land Trusts'. The first CLT in the USA was formed in 1968 to provide access to cheap housing and farmland to impoverished blacks in Georgia. Now in America there are a great many CLTs which have permanently excluded several millions acres of land from real-estate hawks, mining or industrial-forestry. When the land is held in trust, it can never be owned by a single person. As a social entity it can in theory continue for millennium, and beyond. Some CLTs aim to recreate the

by the bacteria. The second stage of the facility contains eight miniature marshes. They are designed to operate much as a natural marsh does. For half the day, they are flooded, which allows non-oxygen breathing bacteria to digest and decontaminate the waste. For the other half of the day, the marsh is allowed to dry out, allowing air to penetrate. This allows the vital oxygen breathing bacteria to continue the purification process at an optimal rate. Water-tolerant plants, shrubs and trees, are cultivated in the artificial marsh.

Different plants, with different root depths and nutrient requirements, perform a variety of functions in the system. Some remove or break down undesirable contaminants, whilst others entrap heavy metals. The trees can be transplanted as landscape items before they take up a fatal amount of heavy metals. Thus, they are able to lock up these dangerous substances safely in the environment for many, many years. Floating plants, can likewise be continually composted, and thus avoid the problem of having to dispose of a heavily contaminated plant waste.

In the third stage, specific marsh plants are cultivated which target specific metals (hyperaccumulators) with a long term view to extracting useable quantities of ore from them. Sydney Water has only recently woken up to the fact that a substantial amount of gold can be extracted from sewerage.

In the penultimate stage, clams, crayfish, water cress, aquatic ferns, irises, bulbous plants, and other animals and plants are found. These are capable of effectively purifying/filtering the very fine particles of waste that have been passed over during earlier stages. Finally the water is passed through fine crushed gravel. (I draw my information here from; C. & J. Plant, Eds., *Green Business: Hope or Hoax?*, British Colombia, New Society Publishers, 1991, pp.124-132.)

After sewerage the next biggest threat to rivers and coastal waters from our cities is the run of from the storm-drains. Through rendering the city pollution free, and saving our rain water, we hope in time, to see the liberated rivers, lined with trees, washing the dust of the city naturally and harmlessly away for us.

Neighbourhood Design

Most people in Australia are familiar with Strata-Plan housing or apartments. Strata-Plan systems developed out of the need to find higher density home ownership solutions in the face of increasing land prices. Tenants 'own' their house or apartment, but the 'body corporate' is responsible for the management of communal facilities. The body-corporate consists of all the residents. A more exciting alternative is co-housing / community housing projects. Rather than allowing a developers design the neighbourhood, a group of would-be-residents come together to think out how they want to live. This movement, which began in Northern Europe, is becoming more popular all around the world. People

mented by crushed grains as a protein booster, is however, only slightly less productive than fresh manure. Although cardboard waste, because of a high boron component, cannot be used exclusively to feed worms, they can nonetheless tolerate a reasonably high percentage of this material, once that it has been thoroughly soaked and shredded. The soak water is valuable food because cardboard is bonded with soluble animal glues.

Where there is muck there is money as the old saying goes. The large-scale commercial production of castings and worms is already well underway in many countries. People who fish create a ready and ever-growing demand for live worms. The worm castings are a natural soil conditioner, but can also be added at a level of 10-20% to potting mixes to produce an activated compost. In their pure form castings will provide a superior rate of germination and remarkably healthy seedlings (as growth hormones are given off by certain bacteria present in the castings). Castings can be mixed with water at a 1:5 ratio and applied as a liquid fertiliser, by conventional spraying equipment and with very successful results. The proven benefits of integrating vermiculture with horticulture means that the demand for castings, live worms and capsules is only likely to increase.

Many people are entering the worm-farming business to make money. The basic ideas can however, be applied on both a large and small scale, to solve a wide variety of environmental problems at home, as well as at the neighbourhood or municipal level.

In the home the worm-driven waterless toilet is undoubtedly the most important domestic application of vermiculture. The worms obtain their water from the urine and faces and manage to produce a 90% reduction in mass. The toilet under normal conditions needs to be emptied every three years, and then only to remove the valuable pathogen-free castings. Specially designed "neverfill" backyard composters (they never fill up because the worms just keep on eating the waste) are an obvious advantage over conventional composters. this is because the compost does not have to be periodically turned. A small portable "pooperator", in which dog-poo can be hygienically returned to the soil as castings, has also been developed.

At the municipal or communal level vermiculture could potentially solve many contemporary urban problems. Most notably as method for converting solid sewage into castings and for purifying the waste water (a major cause of blue-green algae infestations) through waste water vermification. Vermiculture also shows promise as a means to reverse the ever-burgeoning problem of pollution resulting from crude land-fill practices:

> The Sovadec Institute of Environmental Technology, Montélimar, France, has a commercial waste disposal unit solely driven by worms, handling 35 000 kg of domestic garbage every day. The system was commissioned in September 1991

and performed so successfully, the capacity was doubled within six months of opening. The worms are confined in baskets, $5m^2$, and 4m in depth. The garbage, with contaminants removed (glass, plastics & metals), is first composted in a cellular system and then fed onto the top of the baskets. Castings are removed from the bottom in a continuous process. About 20 000 kg of castings are produced daily and these go to manufacture a variety of potting mixes, germinating mixes and soil conditioners. The system also produces organic vegetables and cut flowers in and extensive greenhouse system. (*Earthworms in Australia: A blueprint for a better environment* by David Murphy, Victoria, Hyland House, 1993, page 83.)

Worms, like many plants and trees also have the ability to ingest and tolerate surprisingly large quantities of heavy metals. Although research is still at an experimental stage, worms are showing much promise as a method of decontaminating toxic sites.

Urban Food

At first sight the city does not look very promising as a source of food. The three dimensionality of the city scape can however offer a surprisingly large contribution to the family diet. Fruit trees can be trained up walls. Flat roofs and balconies also offer significant opportunities for food production. Roof gardens are also good insulators and can provide significant energy savings.

Tower blocks designed from light reflective materials could have glass houses on their peaks raising seedlings. These can be planted in carefully designed balcony gardens that are fed and watered by liquid-castings from worm composters and grey-water filtration and pumping systems in the buildings basement. Rice, potatoes & wheat are cheap in relation to salad and vegetable crops. Herbs and salad vegetables that are eaten within a very few minutes of being picked have a much higher nutrition value. Salad Bowl/Oak Leaf lettuces, spring onions, chillies, and other vegetables harvested over long periods are ideal. Herbs which are best used fresh, and are expensive to buy, are relatively easily raised in window box culture. In this way, a large percentage of the surface area of our tower blocks, could become productive.

Kitchen Gardens

Vegetable gardens, because of the amount of manual attention they receive, can be many, many times more productive that those grown in the open field. The kitchen garden should be placed as close as possible to the kitchen. Ideally so that it can be seen through the kitchen window. (This is the best place. However many parents with young children like to reserve the area in front of the kitchen window as a safe play area.) When the vegie garden is placed near the kitchen, produce can then be easily collected, and little energy is expended in attending to its needs. Popping out to side-shoot the tomatoes, whilst waiting for the cake to rise, becomes a welcome break from the kitchen. When the vegie

in large quantities as animal fodder in many parts of Africa, India and Asia. Like water hyacinth, duckweed floats on water and can purify waste water in much the same way. Unlike water hyacinth, their small size makes them very easy to harvest. They are readily consumed by a much wider range of animals--including cattle, herbivorous fish (eg. grass carp), poultry and waterfowl.

Reeds and other emergent aquatic plants (cattails, papyrus, soft rush etc.) when planted on gravel beds are also able to decontaminate wastewater. Their long tuberous roots are capable of transporting oxygen to the deepest levels of the bed or lagoon. The reeds, when harvested, are useful for many products. These include: basket weaving, furniture construction, thatching, fences, windbreaks, paper pulp, mats, fuel, food (from the pith and young shoots) Reeds can be processed to derive pentosan sugars for making compressed fibreboard. Vertical reed beds have been developed that can decontaminate sewerage down the sides of buildings. (Information in this section is taken from: *Making Aquatic Weeds Useful* , National Academy of Sciences, Washington, 1976 & 1987, see also *Food, Fuel, and Fertiliser from Organic Wastes*, National Academy of Sciences, Washington 1981)

Living Machines

Artificial lagoons or beds of hyacinth, duckweed and reeds, when used out of doors are only suitable as a "final polish" to sewerage waste-water and are slow and inefficient for treating raw or solid sewerage. Recent pilot experiments in treating heavily contaminated raw sewerage, by similar methods, under glass, do however, show much promise.

One successful example is the Centre for the Protection and Restoration of Waters solar aquatic facility at Harwich, Massachusetts. The project is an attempt to purify waste from local residents septic tanks. Septate is anywhere between 30 to 100 times more concentrated than ordinary sewage and contains a proportionately higher amount of heavy metals and toxins from other household wastes. For these reasons it is both difficult and expensive to chemically treat this material. The indiscriminate dumping of which was causing seriously contaminating the ground water upon which the residents were dependant. The Aquatics Septate Treatment Facility is designed to process the septate of about 150 families. In theory a very much larger facility could be constructed.

The gossamer shaped greenhouse, which contains over a 1000 species of different kinds of organism, accelerates, by means of a contained and high-light environment, processes which would take several months in lakes and streams, in less than a week. The facility consists of a series of chambers corresponding to different stages in the purification process. In the first stage, the raw septate becomes rapidly populated by algae and bacteria. This is continually grazed by aquatic snails. The roots of microscopic as well as larger floating plants, such as water hyacinths, also begin to take up minerals and foods that are broken down

poses. The role of aquatic plants is to remove inorganic nutrients from secondary wastewaters. They should not be used or consumed if they come into contact with raw sewerage.

Water Hyacinth is a tropical and warm-weather plant that is classified as a weed in more than 50 countries. This is because its vigorous and invasive growth, impedes rice production and clogs up irrigation canals and reservoirs. The problem has been greatly exacerbated by enrichment of natural waters by fertiliser runoff and other human and agricultural wastes. In tropical areas it may double its area every 6 or 7 days. When cultured and regularly harvested, however, it removes algae, faecal bacteria, suspended matter and odour-causing compounds. The improvement in water quality, is in part due, to the bacteria feeding zooplankton, which floating weeds encourage. This is due to the fact that reduction in wind and wave action allows suspended matter to settle more easily. Wastewater effluent passed through beds of water hyacinth is odourless and contains little nitrogen.

Unlike many terrestrial plants, water hyacinth, without any additives can be used as a feedstock for anaerobic bacteria. When digested in sealed tanks it can produce a biogas containing 70% methane and 30% carbon-dioxide. This gas although not suitable for engines (unless the carbon-dioxide is removed) can readily be used for heating and cooking. The liquid sludge left over after the gas has been produced can be used as an organic fertiliser. Many other aquatic plants, such as duckweed show promise as feedstocks for methane producing bacteria.

If water hyacinth is harvested when lush and full-stemmed, they can, once partially dewatered and shredded, be fed directly to cattle, sheep, goats, donkeys and pigs at a rate of about 10-20% of their usual feed rations. With the addition of some carbohydrate, such as by-products of rice, grain or sugar-cane processing, it can be ensiled to produce a palatable, digestible and nutritious silage that is readily accepted by sheep and cattle. The high quantities of minerals, such as sodium, potassium and calcium, in both the dewatered and ensiled plant matter, means that it cannot be fed to ruminants at a rate higher than 10-20%.

Water hyacinth when chopped and mixed with small amounts of earth, ash and animal manure, can be easily, though labour intensively, composted in about 12 days. When chopped and lightly pressed, it can be piled up for several months. This produces a substitute for peat-moss. This is widely used as a component of potting mixes and in the manufacture of "peat" pots.

Duckweed in varying forms is found throughout the world. One species, the smallest flowering plant on Earth, has been cultivated as a vegetable in Burma, Laos and N. Thailand for many generations. It is a potentially significant food source in many other tropical and sub-tropical areas where it is native, as it can double its numbers in 3-4 days. Duckweeds of one type or another are harvested

patch is located at a distance, then such tasks become an irritable chore as they involve a special trip to the end of the garden. Many flowering plants can serve a useful function in the vegetable garden , such as tagetes (marigolds) controlling eelworms on tomatoes. The intelligent use of companion planting allows for a colourful garden, through using flowering herbs and colourful salad plants. Moreover, it can be equally as productive as a vegetable garden without them.

To minimise labour, the 'no-dig' system of vegetable garden is preferable. Leaves or green manures are used as a mulch on the soil surface. A layer of cardboard or newspaper is usually laid down upon the soil surface, prior to laying the mulch. This increases its effectiveness. Woollen carpet, laid several months before planting, eliminates dense, wooded or deep-rooted weed infestations. The carpet, once covered with mulch will rot down harmlessly over a couple of years. The aim of mulching is not to eliminate weeds. Its goal is to reduce them to a minimum whilst increasing the water-retaining capacity and organic content of the soil. A few weeds can often increase the bio-diversity of the garden. If weeds are cut down before flowering they can be used as green manure on the soil surface. Perennial weeds, such as dock and dandelion bring up nutrients from deep in the subsoil. These can be continually cut and used as a green manure in much the same way. Other common weeds, such as fat hen or chickweed are edible. They can be used as an alternative to spinach or as the base for a soup. Weeds, when uprooted and soaked in water until rotted provide a diluted manure 'tea' for watering plants.

By not digging the soil worm populations increases. This in turn, increases the overall volume of living soil biota, naturally adding to soil fertility. Compaction can be a problem with the no dig-garden. It is often advisable that it be undertaken in raised beds. In this way it can be easily reached from well constructed pathways. Plants that require little attention can be placed a long way away. Those requiring a daily visit can be grown closest to a pathway. By constructing narrow paths from large paved circles, the surface area that can be reached without treading on the soil can be significantly increased. Where slugs present a problem the inclusion of a frog pond or ducks into the garden ecosystem is usually far more effective than chemical pellets. Native Australian snails are carnivorous. They will eat the others. Experimentation will soon reveal if any are cannibals. They should be encouraged as they will eventually eat their own as well as other snails. Thereby reducing snail numbers further.

Urban Food Forests and Lakes

The inclusion of ponds within domestic architecture is desirable for many reasons. By tapping water from the bottom of the pond, a nutrient rich-liquid fertiliser can be used in irrigation. Ponds are also a useful tool in firefighting. Water reflects light, cools hot summer winds and adds warmth in winter. A large body of water close to the house can reduce the need for heating and air-

conditioning.

Larger gardens, communal lawn areas in housing estates and municipal parks, all represent valuable areas of space in the city-scape. Our aim is to make these productive in food whilst retaining the recreational and aesthetic needs of the people. City people will have to learn to give up the parcel-like mentality towards urban land usage. It will be necessary to pool their back yards to create viable areas of space. Communal space that can include ponds at the lowest points and forests on the steeper ground, whilst still leaving areas for meadowland, recreation and sport. By using edible plants in natural eco-systems such as micro meadow, marsh and forest land, a great variety of wild life can be encouraged into the city, whilst providing wholesome food to its inhabitants in a sustainable way.

An open field growing a single crop in one layer is a very unproductive way to manage the land when compared to a forest. A forest has a canopy consisting of the highest trees and then several lower layers of smaller trees. Large and small shrubs make up further layers, as do herbs and ground cover plants. Then there are fungi and tubers that do most of their growing under the ground. Climbers, vines and wide variety of other plants exploit different niches in the forest infrastructure. Overall food production in the form of nuts, fruits, bulbs, fungi etc., is in every respect many, many times greater than a field of grain or beans. The whole system is also self-fertilising through producing large amounts of organic matter in the form of leaves, twigs, dead animals and trees. The urban-food forest can effectively feed itself. Also the great diversity of plants in a forest leads to symbiotic relationships and a plethora of useful connections that enhance its fecundity and productivity.

Communalised gardens and parks can be designed to include areas of woodland or orchard entirely made up of food plants. This can provide the community with significant supplies of nuts, fruits, berries, herbs and flowers. Self-sustaining edible forest eco-systems require less maintenance and are no-less beautiful than traditional herbaceous borders and rose gardens.

An example of an urban food forest in a temperate climate might consist of: a canopy of fruit trees such as apples, crab apples, pears, plums; giving way to a layer of dwarf fruit trees and hazels. Below them a shrub layer of soft fruit, such as black, red & white currants, gooseberries and raspberries. Just below the smallest trees there would be a herbaceous layer of herbs, and perennial vegetables, such as fennel, globe artichokes, lemon balm, marjoram, mints, nettles, rhubarb, rosemary and sage. These are interspersed with other non edible useful plants that give nitrogen or other valuable elements and minerals to the soil. Examples of this such plants that have attractive flowers and foliage might be, broom and comfrey. A ground cover layer of edible horizontal ground hugging plants such as strawberries, land cress, wood sorrel or good king Henry would be

tion:

> On the basis of the exhaustive study which was undertaken, it must be concluded that the land application of wastewaters offers a viable alternative to advanced treatment processes and deserves serious consideration by many communities and industries throughout the United States. Land needs, when taken in perspective with total land uses, are not unreasonable and many, in fact, play a desirable social role by providing green belts and open areas, and preserving rich farm lands and cloistered areas. The conclusions of the report point to the almost unqualified success of this method of application, both in this country and throughout the world, when the facility has been properly operated and efforts have been made to apply sound engineering and geological and farming expertise to design, construction and control procedures *(More Water for Arid Lands, pp. 45-6)*

Living Plant/Animal Cleansers

Waste water irrigation is however only one part of the story. The solid sewerage waste still has to have been dealt with. This often contains high concentrations of heavy metals, salt and harmful viruses. Organic and environmentally safe methods of sewage disposal have been practiced by numerous civilisations of the past. Shallow light & oxygen rich ponds, in which fish filter the excrement, have been successfully practiced in India and China for many thousands of years. As longs as the fish ponds are shallow enough so that sunlight can penetrate to the bottom, there is little health risk. In fact Ultra Violet light can by itself act as a decontaminant. Experiments with devices that test this idea are promising. Other experiments with the use of sound-waves as a way of disintegrating and decomposing solid wastes have also been undertaken with some positive results. The management of solid matter, and the decontamination of waste-water, in the modern city, has, on the other hand, been dealt with by harmful and unnecessary chemical treatments. Although carbon-filtering can cleanse the waste-water of many harmful organisms and impurities, the high concentrations of heavy-metals has proved more problematic. Thankfully the development of worm treatment and reed beds, is beginning to show us a way of processing and decontaminating both solid and water waste, by using living, rather than chemically engineered systems.

It has been known for many years that natural or artificial beds or marshes, growing bamboo, water hyacinth, duckweed, reeds and other aquatic plants can strip wastewater effluent of pollutants. Like worms, many of these plants are able to accumulate high concentrations of heavy metals and other intractable pollutants. Although they can be used to treat raw sewage (if diluted) this process (out of doors) takes a whole season. Moreover, the plants when harvested may often be contaminated and unsuitable for feed or compost. When used to purify secondary wastewater after primary sewage treatment (in especially constructed beds or lagoons) the plants can be regularly harvested. Some aquatic plants have phenomenal growth rates and can be used for a wide variety of pur-

part of an integrated urban-food-forest all of these creatures can be grown virtually cost-free.

(Information is this section obtained from '*Micro-livestock*', National Academy of Sciences, Washington DC, 1991)

Water Management

We have damned, diverted, drained & dirtied our fresh water supply. All over the world people are becoming more and more concerned with water quality. Sales of containerised mineral waters are increasing with alarming rapidity. Many people are considering buying a filtering system for their tap water, for the first time. At the present time, we uselessly flush into our sewers: rainwater from the roof, grey-waters from the sinks and showers; and black water from our toilets into our sewers. This is an obvious case of throwing babies out with the bath water. Rainwater tanks can yield a large percentage of the family water needs if used carefully. Where air pollution is a problem, a solar distillation system is an effective way to provide the house with a constant natural supply of purified water. The greywater is another squandered resource. It can be easily filtered and used for supplementary plant watering. New suburbs in Sydney's west, are having experimental systems placed in their communities. These consist of two colour coded taps. One providing filtered grey water or treated secondary sewerage water for the garden. The other for drinking and washing. Generally we must attempt to capture and reuse all available water as many times as possible before it enters the river system.

Sewerage

Since 1982 Melbourne, Australia, with a population of several millions has disposed of its wastewater in irrigation at the 109 km². Board of Works Farm at Werribee. This large facility has attracted international attention:

> A total of 4,200 ha of the farm is employed for irrigated pasture of which 1,370 ha are used for grazing 15,000 head of cattle through the year. Forty to fifty thousand sheep are fattened during spring and summer. Health restrictions are imposed only on the sale of cattle and sheep for slaughter—but the 0.02 percent condemnation rate of cattle carcasses is the same as that for the surrounding area. No higher incidence of disease among farm employees has been found to result from their employment. In less well operated sewage irrigation projects in India, however, the operators have been found to have abnormally high loads of parasites (*'More Water for Arid Lands: Promising Technologies and Research Opportunities'*, Washington, National Academy of Sciences, 1974 & 1987, p.46)

Unfortunately the contamination of bio-accumulative dioxins from certain industries in Melbourne has seriously undermined public confidence in the facility. More generally, the concept of using wastewater for agricultural irrigation has achieved the unqualified support of The American Public Works Associa-

complimented by vertical climbing plants such as beans, (thornless) blackberries, grape vines and hip bearing (thornless) roses. Shade loving plants, such as parsley, are able to fill specific niches. A rhizosphere (or underground layer) of horseradish, Jerusalem artichoke and truffles completes our picture of what an imaginary urban food-forest might look like. The aim is not to replace natural woodland with food forests, but rather to allow us to reafforest our urban landscape in a useful way. Trees provide homes to all manner of insects and animals and edible native plants which spring up can be integrated into the food-forest.

Useful or edible marsh and meadowland plants can be introduced into natural and artificial wet-land eco-systems. Because fish are cold-blooded and do not use energy for body warmth, aquaculture is one of the most efficient methods of obtaining high quality animal protein. Although the details are different the same principles apply; that of: maximising the number of useful connections between different plants and animals through working as closely as possible with the broad dynamics of meadow and wet-land ecology.

Dams constructed at the lowest point of a group of dwellings can be used to store grey water, which is then reused in aquaculture systems which cleanse water of toxins and excess nutrients before entering natural rivers and lakes.

Neighbourhood gardens

Neighbourhood gardening is not a new idea. In England, the allotment system, where a local resident can use a small patch in a communal field to grow his or her vegetables, has been successfully operating for many years. Although once a declining practice, the renewed interest in gardening has led to many allotment blocks, that were threatened by 'development' through under-use, being preserved by community action. In other places throughout the world, urban waste-lands have successfully been turned into communal gardens, through local direct action. The value of these type of ventures is that people are able to discuss problems, ideas and gardening tips with one another, the common purpose being to make a shared piece of land as productive as possible. The potential of this worldwide movement, by groups of committed gardeners, to preserve or reclaim urban land for food production, is very great indeed. Common ground held by Community Land Trusts for the purpose of providing local residents with a place to grow their own vegetables (in perpetuity) is a sure and steady way to make our cities both greener and more self-sustaining.

Community Supported Agriculture

All of us would like to see the modern mega city replaced by smaller and more well-rounded settlements. In the short term we have to accept that people can only meet a percentage of their basic food needs from urban gardens. Community supported Agriculture is a cover-all term for various methods of directly linking consumers to organic farms. Local farms or those within easy travelling

distance or the same bio-region can deliver a weekly standing order for a selection of basic vegetables. Alternatively people may prefer to invest in a farm in the form of a community land trust that can be managed by a professional farmer to provide them with fresh produce and income. Rather than taking an expensive holiday package many urban dwellers would relish spending their free time relaxing or doing healthy work on the farm. Other consumers prefer to make a single large payment to an organic farmer at the beginning of the year, on the understanding that they will be supplied with the produce they desire.

Organic farmers are often held in an economic strangle hold by the supermarket chains. Much of the produce does not meet the aesthetic and standardisation criteria of these concerns. A prohibitively large amount of what they grow cannot be sold to them. This is one of the reasons why organic food is often priced higher than that grown by conventional methods. Organic produce that is slightly spoiled, small, or odd-shaped produce can still be sold. This is because the consumer knows that it is fresh and trusts the place where it came from. The same consumer presented with exactly the same item on the shelf in a supermarket would almost certainly not buy it. Also fruit is expensive in supermarkets because it is often transported hundreds of miles to a central depot. And then only to be brought back hundreds of miles back home again to be sold in the local store. This not only wastes energy but results in the farmer not receiving very much for his or her fruit. The consumer is likewise forced to pay for these inefficiencies. Beyond this, the organic farmer for political reasons, would often like to sell his produce directly to the consumers in the local community. In Japan, hundreds of thousands of consumers are linked in these ways directly with farmers. This has inspired a growing number of people in America and Europe to do likewise.

Urban Micro Livestock

There are many breeds of exceptionally small sheep, cattle, pigs and goats which could conceivably be raised within an urban context. Small animals, such as bees, chickens, ducks, geese, guinea pigs, pigeons, quail and rabbits are easier. All of these animals can yield good returns on relatively low inputs. Bees are ideal within urban situations. They can be kept on flat roofs or balconies then their flight paths does not interfere with human traffic. If they are provided with ample forage from city flower gardens a good year many jars of honey is not uncommon from one hive.

Where chickens are housed in moveable pens they can be used as a plough. In about two weeks the chickens will have removed all the green matter and scratched up and fertilised the land so that it is ready for planting or sowing.

Chickens give good meat and provide eggs. A large percentage of their food can be obtained from wastes from the kitchen and vegie patch. The meat and eggs obtained from chickens is much more valuable than using the kitchen

scraps as compost. Compost bins in urban situations tend to attract undesirable pest animals. By ensuring that all the living & non-living components of an organic recycling system work in closed loops we can obtain useful products at every stage. By employing useful animals within integrated systems we can eliminate sewers & rubbish piles and the rats and the cockroaches that inhabit them. At present, these pests thrive in our cities, because we provide them with food. When this food is eaten by urban micro-livestock we not only receive superior food in return, but resolve the problem of having to control pest infestations with dangerous chemicals.

Unlike chickens which scratch up the ground, ducks are wonderful around the garden as they readily gobble up slugs and snails. Although raising rabbits takes more time & skill than chickens and other scavengers, they are especially well adapted to backyard rearing systems in which capital and fodder resources are usually limiting factors. They can do much to improve the family diet of many needy families. In theory, a single male and four females can produce as many as 3000 offspring a year. This represents some 1500 kg of meat—as much as an average sized cow. Rabbit-meat has more protein, less fat and more calories per gram, than beef, pork, lamb or chicken.

In consequence of this many countries are promoting small-scale urban production through advertising campaigns and school education programs. The long-haired Angora Rabbit yields a luxury fibre (as much as 1kg per rabbit and usually mixed with fine Merino wool). The fur and leather of more familiar breeds can represent a valuable source of income. Rabbit manure is an excellent fertiliser. It contains high proportions of nitrogen, phosphorus and potash. Rabbit droppings, unlike poultry manure does not need to be composted. It can be immediately dug into the soil or placed around plants. The familiar pet Guinea Pig, is perhaps the ultimate user friendly urban microlivestock. They are quiet, odour free and are kept loose in thousands of dwellings in the Andes. Here they have been traditionally raised and eaten for centuries. The low cost of these small animals makes them available to landless peasants and the urban poor. They convert kitchen scraps and very low value fodder into meat. 20 females and 2 males may produce enough meat year-round to provide an adequate meat diet for a family of 6.

Pigeons are mostly able to feed themselves. They provide excellent meat when eaten at about 4 weeks old. Their eggs are good to eat and they produce a phosphate rich manure. Pigeon droppings, which now destroy the embellishments upon old and treasured buildings, in many of our ancient cities, would to a much greater extent be contained in dovecotes. The droppings could then be usefully recycled as manure in urban and community gardens. Urban microlivestock will eat a wide variety of foods from garden weeds to the leaves of certain trees. If plants favoured by particular animal can be grown nearby or as